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Indian Standard

PACKAGING CODE

PART IV PACKAGES

Section 1 Metal Containers

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INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
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Indian Standard

PACKAGING CODE

PART IV PACKAGES

Section 1 Metal Containers

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Indian Standard

PACKAGING CODE

PART IV PACKAGES

Section 1 Metal Containers

0. FOREWORD

0.1 This Indian Standard (Part IV/Sec 1) was adopted by the Indian Standards Institution on 28 January 1982, after the draft finalized by the Packaging Code Sectional Committee had been approved by the Marine, Cargo Movement and Packaging Division Council.

0.2 It has not been found possible to prepare the Packaging Code as a complete volume and is therefore being issued in the following parts, each having one or more sections:

Part I Product packaging
Part II Packaging materials
Part III Ancillary materials
Part IV Packages
Part V Packaging operations
Part VI Handling, storage & transportation
Part VII Packaging machinery
Part VIII Testing

This section, Part IV, Section 1, deals with metal containers only.

0.3 Metal containers find wide application as unit packs as well as bulk packs in the packing of liquids, semi-solids and solid powder or granular materials. With proper choice of the material and the internal coating material, they find wide acceptance for products like fruit juices, food products to highly hazardous chemicals and petroleum products. In this section various types of metal containers have been covered with a brief outline of their usage, technical specifications with respect to their materials of construction and dimensions, and selection for various products.

0.4 In the preparation of this standard, considerable assistance has been derived from BS 1133 : Section 10 : 1966, Packaging code : Metal containers, issued by the British Standards Institution (BSI).

1. SCOPE

1.1 This standard lays down guidelines on the types, materials, construction and selection of various types of metal containers used as unit packs and bulk packs for materials.

1.2 The types of metal containers covered in this code have been classified as under :

a) Tins and cans;

b) Drums;

c) Metal crates, hampers and trays; and

d) Metal collapsible tubes and rigid tubes.

2. TINS AND CANS

2.0 The terms 'tin' and 'can' are customarily distinguished by the use of the word 'can' for a food can with an open top and 'tin' for other containers. However, this usage, is not universal and for all practical purposes the two words are synonymous. Tins and cans are light for economical handling, readily opened, impervious to air, light and water, and may be easily decorated, thus obviating the use of paper labels, which tend to get detached. Tins and cans are not normally made with base dimensions greater than 280 mm diameter or 300 mm diagonal measurement. The sheet thickness and the construction of tins should be appropriate to the weight and nature of the contents.

2.1 Materials — Tinplate, blackplate (tinplate base), aluminium and aluminium alloys are the base materials used in the manufacture of tins and cans. Under normal conditions of storage and use, these materials are suitable for surface treatments, such as lacquering and printing, and in the appropriate quality are suitable for:

a) shaping operations, for example, stamping, drawing, folding, bending and ironing.

b) assembly work, for example, joint forming, soldering and welding.

NOTE — Aluminium and blackplate are not normally used for the fabrication of containers having soldered seams.

When ordering, it is recommended that the manufacturing process for which the material is intended be stated.

Details of the materials are given in Part II Packaging materials, of this code (*under preparation*).

2.2 Protection Against Corrosion

2.2.1 Tinplate is partially rust-proofed form of steel, and the tinplating process is fairly effective relative to its cost. However, the protection is only partial, as the tin coating is not continuous and its porosity is increased by the subsequent fabricating processes.

Lacquering and decorating of tinplate sheets is carried out prior to fabricating the container and this, too, gives partial protection. Although this applied film may not be wholly continuous, lacquering is still worth while. Attention should be paid not only to the physical and chemical properties of the lacquer itself, but also to the adhesion and continuity of the lacquer film after application and stoving on the plate and after subsequent shaping operations and assembly work.

Tinplate is susceptible to corrosion by condensation, the degree of corrosion being dependent upon the coating thickness. Storage of tins in unheated warehouses with day and night temperature gradients should be avoided. Parcelling of the tins and their packing in fibreboard cases reduces the hazard but does not eliminate it. Attention should be given to the materials used in the manufacture of overpacks, labels and label adhesives. For example, materials with high chloride and sulphate contents will accelerate corrosion of tinplate under moist conditions.

Lacquering and decorating of tinplate base (blackplate) should be carried out soon after rolling. Unprotected steel is exposed at the cut edges of the various components from which the tin is built up. In the case of lacquered tinplate base, underfilm corrosion can spread from these edges. For testing of lacquers (*see* IS : 197-1969*).

The post-lacquering of fabricated containers should prevent broken and distorted coating films, but three are production difficulties which have prevented the manufacturers of containers from developing this for general production.

Where a tin is printed (lithographed), it is usually protected by a film of varnish, which may have a matt or glossy finish. These applied

*Methods of sampling and test for varnishes and lacquers (*first revision*).

coatings are usually less than 0·00 127 mm thick in order that they may withstand the stress of subsequent fabrication.

Owing to the naturally formed oxide film on its surface, aluminium is inherently resistant to attack by a great variety of products and this resistance can, to some extent, be increased by anodizing. However, the application of a protective lacquer coating is required in certain instances. Shallow containers may be pressed from anodized and/or lacquered strip, and deep-drawn containers may be spray-lacquered when necessary.

Surface coatings on the outside of aluminium containers are not necessary on protective grounds and external lacquering, enamelling, etc, is usually applied for decorative purposes only.

2.3 Basic Types of Tins and Cans

2.3.1 A tin is normally classified according to its type of closure, but the true definition of basic type relates to the body. There are only three basic types:

Seamless (or 'solid drawn') body,

Locked (or 'seamed corner') body, and

Built-up (or 'rolled') body.

Impact-extruded containers are made in aluminium, and these are described separately in **2.4**.

2.3.1.1 *Seamless body type* — This type has a body drawn or pressed to shape in one piece, free from any form of joint (*see* Fig. 1). The work is usually completed by the follow-on operations of trimming, beading and curling.

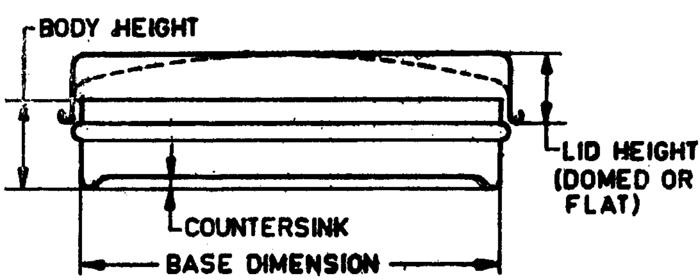


FIG. 1 SEAMLESS (OR SOLID DRAWN) TIN

Cylindrical shapes are used for such products as household polishes, ointments, etc.

Rectangular and square section shapes are used for dry non-homogeneous products, such as cigarettes, tobacco and pastilles. A truly square corner cannot be made (*see* **2.3.1.2,** ' Locked corner body '), and the deeper the body, the greater must be the corner radius. As a rough guide, the relation of corner radius and finished depth of body should be of the order of:

Body Finish	*Corner Radius*
Curled (inward)	Not less than 60 percent of finished depth of body
Raw edge	Not less than 40 percent of finished depth of body

Up to 115 mm diameter, the round seamless tin finds a ready and proper use; beyond this, it tends to be less satisfactory economically and functionally.

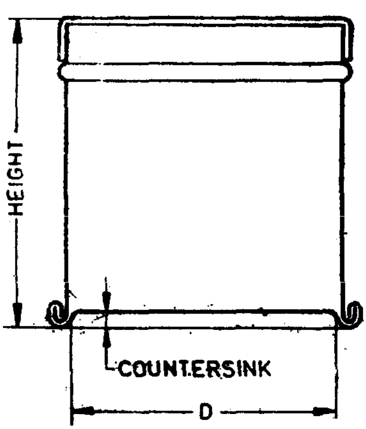
The size range for rectangular and square section shapes is determined by the functional use of the filled tin and by economics; seamless tins, whatever their shape, are usually flat packages of large surface area relative to their depth.

2.3.1.2 *Locked corner body* — This type falls between the seamless and built-up body and has certain characteristics of each. It is peculiar to ' flat-sided ' shapes and an interlocked seam formed on each corner produces a very sharp, though not truly square, corner. The body is in one piece and the flat sides between the corner points are finished by folding the edge.

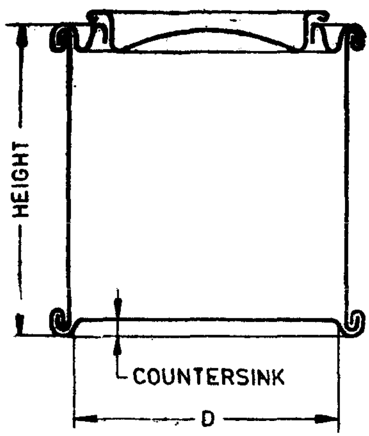
The square corners are the significant characteristic. The corners are mechanically secure, but not normally sealed. Generally speaking, there is no limitation to the length or depth of the body.

2.3.1.3 *Built-up body*

2.3.1.3.1 *General purpose tins* — This type of body consists of two parts secured together, namely, a side wall and a bottom. The side wall is rolled or formed and is secured by a side seam joint. The body may be fitted with some form of top or closure, which may be separate from, or secured to, the body (*see* Fig. 2).



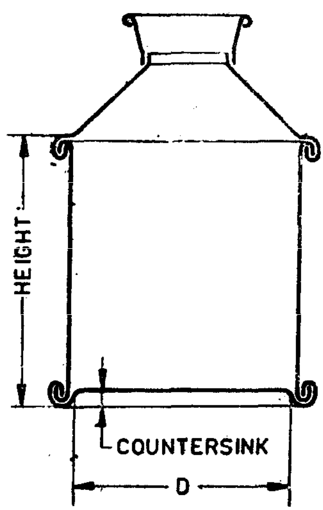
a) SLIP LID OR HINGED LID TIN



b) LEVER LID TIN

The symbol D represents any of the following dimensions (*see* Table 1):

i) Diameter of circular section tin
ii) Length of sides of square section tin
iii) Length of diagonal of rectangular section tin
iv) Length of major axis of oval section tin



c) CIRCULAR SECTION OR SQ SECTION TAPER TOP TIN

FIG. 2 BUILT-UP (OR 'ROLLED') BODY TINS — *Contd*

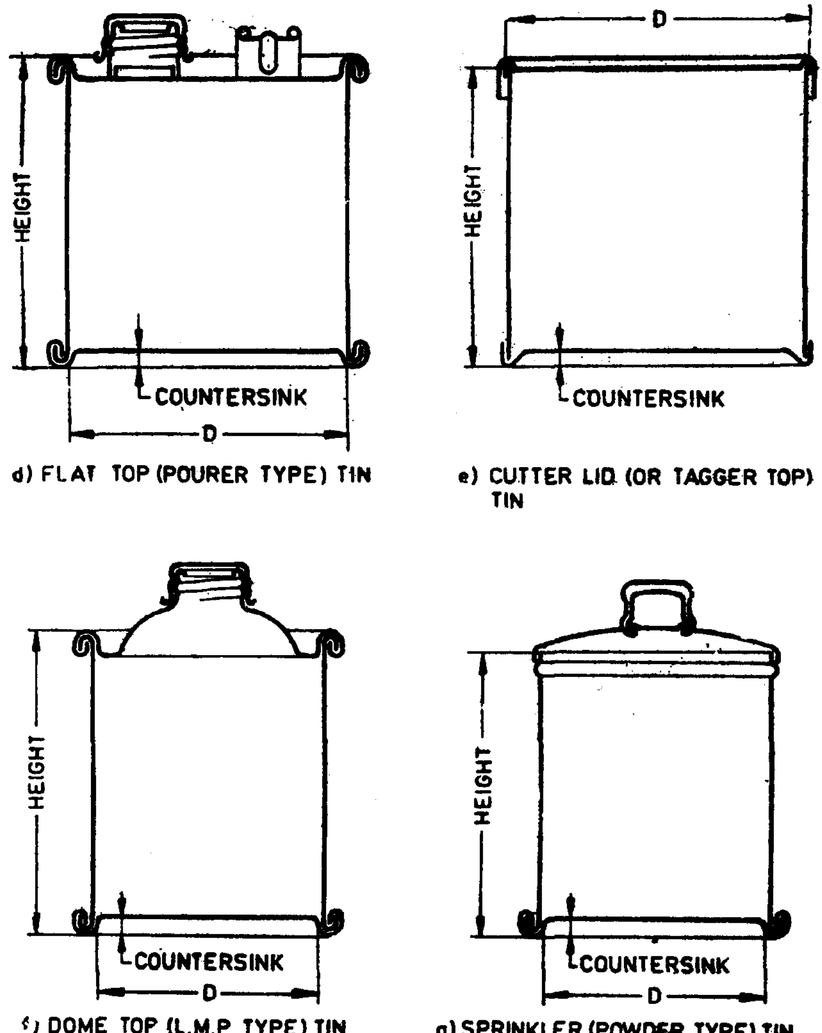


FIG. 2 BUILT-UP (OR 'ROLLED') BODY TINS

Except for the cylindrical shape, or locally at the corners of flat-sided shapes, the body derives no structural strength from its section. This is important, since although the attachment of the bottom imparts great local rigidity, the top can be distorted unless it is secured mechanically

by the forming of another permanent joint with a third integral component. Some stiffness is imparted by forming a bead, curl or fold at the 'open' end. This is most effective on small and medium size tins. A further increase in the rigidity in the larger diameters can be attained by corrugating the body.

The common size of tinplate sheet is not more than 910 mm long and the periphery of tins having side walls in one piece should be within this limit. The side seams of bodies that are in two pieces should be soldered for strength.

A fundamental difference in strength exists between tins of circular section and of other shapes. The even stresses and the strength of section of cylindrical bodies permit the closure of open-ended bodies, for example, slip lid types, to be made with both lid and body in a state of even tension and compression. With square section bodies, the corners, being relatively rigid, transmit the forces of compression to the flat sides, which since they are restrained by the lid from moving outwardly, bow inwardly.

The influence of material consumption upon choice of shape is significant. The 'built-up' type is preferable from the point where the seamless or locked corner is too extravagant or does not provide the intrinsic depth needed. The effective size limit varies with the particular shape, type and function, the considerations being:

a) inherent rigidity, for example, slip lid, lever lid or flat top.

b) shape (circular section, square section, rectangular section or oval section)

c) support provided by contents, for example, products which set solid after filling.

The dimensional limits given in Table 2 are those generally accepted.

2.3.1.3.2 *Hermetically sealed or open top sanitary cans* — A highly specialized form of 'built-up' container, the 'open top can' (*see* Fig. 3) usually comprises three parts : a side wall, an end fixed by the can maker, and an identical end supplied loose for fixing by the canner after filling and before thermally processing the can and its contents.

The physical, chemical and bacteriological 'stresses' involved in food canning create an exacting requirement. These cans have the simplest construction of rolled body ('built-up') in order to meet the standard of performance required. There is little scope for compromise or chance : the high speed at which they are produced are a product of this constructional simplicity and not the cause of it.

TABLE 2 DIMENSIONAL LIMITS FOR BUILT-UP BODY TINS AND CANS

Shape	Type	Reference on Fig. 2	Characteristics	Maximum Dimensions of Base *D* (mm)	Maximum Weight (mm)
Circular section	Slip lid	(a)	Side seam not soldered	229	229
			Side seam soldered	241	305
	Lever lid* Taper top* Flat top* Dome top*	(b) (c) (d) (f)	Side seam not soldered	241	305
			Side seam soldered	280	432
Square section	Slip lid or hinged lid	(a)	Side seam not soldered	152 × 152	152
			Side seam soldered	235 × 235	381
	Lever lid* Taper top* Flat top*	(b) (c) (d)	Side seam not soldered or soldered	235 × 235	381
Rectangular section	Slip lid or hinged lid	(a)	Side seam not soldered	330 Diagonal	254
			Side seam soldered	330 Diagonal	305
	Lever lid* Flat top*	(b) (d)	Side seam soldered	330 Diagonal	381
Oval section	Slip lid or hinged lid	(a)	Side seam not soldered	330 Major axis†	254
			Side seam soldered	330 Major axis†	305
	Lever lid* Flat top* Dome top*	(b) (d) (f)	Side seam soldered	330 Major axis†	381

*That is, double seamed top and bottom.

†Assuming maximum ratio of length to width of base as 2 : 1.

The ' stud hole ' type is the original form. Both ends are fitted by the can maker. The canner fills through a centre hole in one end and seals the tin by soldering a ' stud ' or disk of tinplate over that hole.

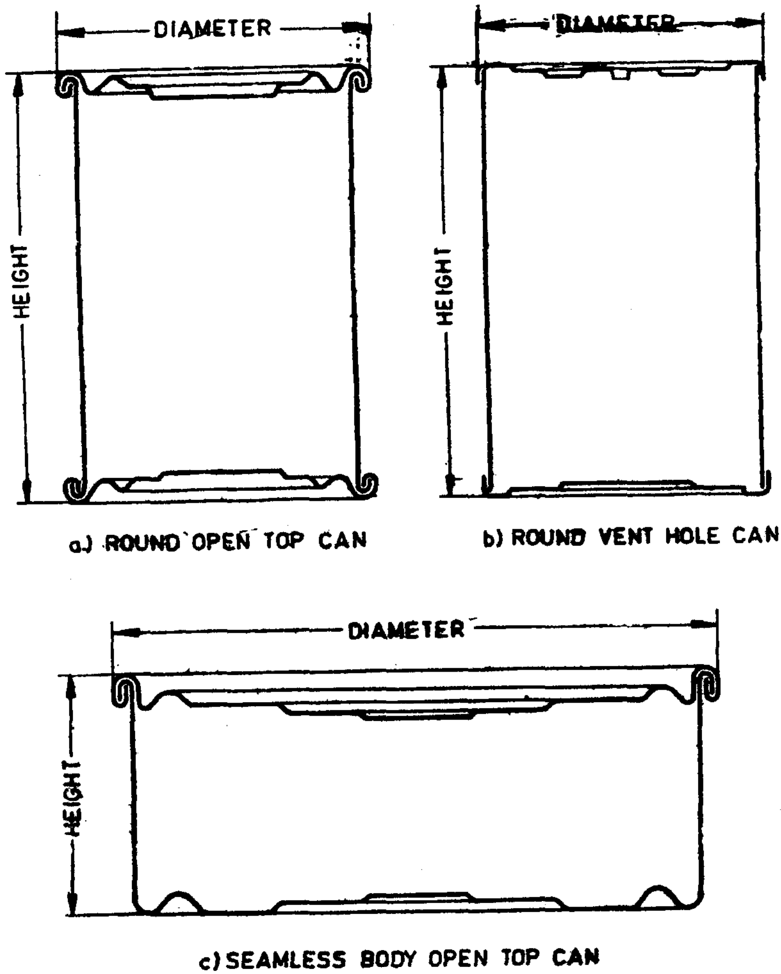


FIG. 3 THERMALLY PROCESSED OPEN TOP SANITARY CANS

The 'vent hole' can is quite different in character and is used widely for liquid milk products. The can is vacuum filled through a very small tapered orifice in one end and sealed by a boob of solder. The can maker fits both ends and uses a 'capped-on' soldered-end construction.

Open top and vent hole cans are made to rigid engineering standards of dimension, construction and performance. They are made in a series of standard sizes, known by name or by their nominal dimensions.

Open top cans are lacquered inside where the contents require it. Each type of product, for example, fruit, vegetables, fish, meat, requires a particular type of lacquer and lacquer application; there is no universal lacquer.

NOTE 1 — Lacquering is not primarily intended to protect the tinplate from corrosion, but rather to preserve the colour and appearance of the food.

NOTE 2 — The flattened can is one in which the rounded can body is flattened for the purposes of reducing packing and transport cost. The flattened can can be reformed to a round shape just before being filled up and closed on two ends.

2.4 Extruded Aluminium Containers

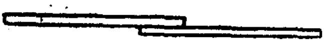
2.4.1 With aluminium, seamless bodies can be produced by impact extrusion, particularly where the depth is large relative to the diameter (greater than a ratio of approximately 1·5:1). Closures suitable for use with other seamless containers are also satisfactory with those produced by impact extrusion. Screw tops are frequently used, particularly for packaging of pharmaceutical products and products of a similar nature.

2.5 Joints

2.5.1 Joints fall into two categories: the mechanically secure joint and the mechanically secure and sealed joint. Tin box making is essentially a matter of making joints and every design calls for a close study of the implied joints. Whether the joint is formed by rolling, spinning or compressing, the forces used must provide their own supporting pressure. An externally applied force must be balanced by an internal support or resistance. The tin itself cannot provide the resistance.

Side seams of 'built-up' bodies are usually formed by a simple interlock. Such joints are relatively robust in tension and weak in compression. Where circumstances require a side seam more resistant to compression, a more elaborate construction is employed, known as the 'Mennon seam'. A lapped soldered joint is also used in certain circumstances (*see* Fig. 4).

Top and bottom joints are almost exclusively rolled or spun to provide varying degrees of interlocking of the flanges. Irregular shapes not only cause sharp directional changes in spinning but also offer unequal flange resistance.



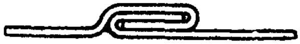


FIG. 4 LAPPED AND LOCKED SEAMS

2.5.1.1 *Joint treatment* — A package is no better than the joints by which it is made. The joints of tins and cans should, therefore, be assessed in relation to the ultimate stresses which will increase with the length of the joint. The shorter the length of joint, the greater is the inherent rigidity. Soldering of properly formed joints achieves two results: it mechanically binds and physically seals the joint. Lining with films or gaskets will seal, but will not add anything to the mechanical strength.

The terms generally used in relation to joints are:

Dry joints	Joints not treated with any sealing agent, lining gasket or holder.
Fully soldered	All joints of the tin (other than the closure itself) soldered.
Welded	The side seam of the can is welded.
Lined (or compound lined)	Before completing the joint one of the two components is coated with a film of ' compound ', generally a rubber latex or synthetic rubber base material. No solvent or vehicle remains at the time the joint is made.
Doped	The joint (usually after completion) is sealed by the surface application of a film of sealing dope. This is usually plasticized, and must be appropriate to the contents and thus covers a wide field, ranging from animal glue (in water) to resins in solvents.
Flanged doped	As ' doped ', but characterized by the application of the dope to the joint during the joint forming operation. Thus, the dope proper, and the vehicle, is incorporated in the joint.

2.6 Closures

2.6.1 *For Seamless ('Solid Drawn') Body*

a) *Round Shape* — The slip lid is the most common closure for seamless body tins; lever lids and screw caps will be considered under 'built-up' body type. The closure is controlled by three factors (if dimensional control be accepted as an over-riding characteristic):

A. Difference between diameter of the lid and that of the body.

B. Depth of engagement of the lid on the body.

C. Relative rigidity of the lid and the body.

D. Atmospheric pressure or internal vacuum inside the assembly.

The most effective closure is the atmospheric pressure type of 'vacuum' seal, which does not involve heat or soldering. A rubber gasket provides the sealing element and the atmospheric pressure difference between the inside and the outside of the tin creates and maintains the seal. To open the tin, the sealing need only be disturbed to restore atmospheric pressure to the inside of the tin. The engagement of lid and body may be as tight or loose as desired to provide an easy re-seal fit during use (*see* **2.9.5**).

b) *Square and Rectangular Section Shapes* — Although the slip lid is used for these, the mechanically attached hinged lid is more effective, since the shape precludes the use of tightly fitting lids. The lid is sufficiently over-size relative to the body to ensure easy alignment. The most effective transit seal can be achieved by pressure-sensitive adhesive tape. The vacuum seal presents many problems with this shape.

2.6.2 *For Locked ('Seamed') Corner Body* — The type of closure is similar to that for the square and oblong seamless tin, but vacuum packing is impossible.

2.6.3 *For Built-up Body* — Here, closures fall into three groups, namely, one-piece, two-piece, and three-piece closures. Figure 5 illustrates diagrammatically the difference between the three types.

a) *One-piece Closure* (*see* Fig. 6). The body (or side wall of the tin), which provides one sealing face of the closure, is of interrupted periphery, since it includes a side seam joint. It is, therefore, impossible to produce a fit which provides a liquid-tight seal. A slip lid serves well where an 'easy' fit is adequate or desired,

for example, for a cocoa-tin. A hinged lid can be fitted only to tins of square or rectangular section.

Since the open end of the body is relatively unsupported, there is a limit to the body height/body diameter ratio that can be used.

b) *Two-piece Closure* (*see* Fig. 7). By seaming a ring to the top of the body, an entirely different set of conditions is created. The side seam is mechanically supported at both ends, and the lid engages the ring without the inherent disadvantage of a seamed joint. Both lid and ring are strong in section and relatively high interference fits may be employed, which makes it possible to provide a liquid-tight seal for products of high viscosity, such as paints.

   The container manufacturer does not assemble the closure; he supplies the components. These are controlled to thousandths of an inch, and it requires only a minute variation to turn a 'hard' fit into an 'easy' fit; care should, therefore, be exercised when lidding.

c) *Three -piece Closures* (*see* Fig. 8). By employing three components in the closure it is possible to provide a restricted orifice while still maintaining the strength and sealing characteristics of the two-piece closure.

In this case, the component which is fixed to the top of the body is fitted with a 'neck' on to which, or into which, the final closure component is fitted.

With internally fitting closures, the seal is usually metal to metal. By employing an external fitting closure it is possible to introduce a resilient sealing wad between the closure components and thus improve the 'liquid-tight' properties. By this means it is possible to achieve a liquid-tight seal for the most searching products. Careful selection of the wad material is essential. It must be both resilient and impervious to the products; the latter is often achieved by using a special facing.

Typical closures are screw neck, with cap and wad (external), press neck, cap and wad (external); and lever neck and cap (internal).

2.7 Decoration (Lithographing and Roller Coating)

2.7.1 *Colour and Matching* — Lithographed tinplate, when protected with a film of varnish, has its own characteristics of reflection and absorption which naturally differ from other media. Copies of colour from other media, such as fabric or paper, cannot be matched identically on metal.

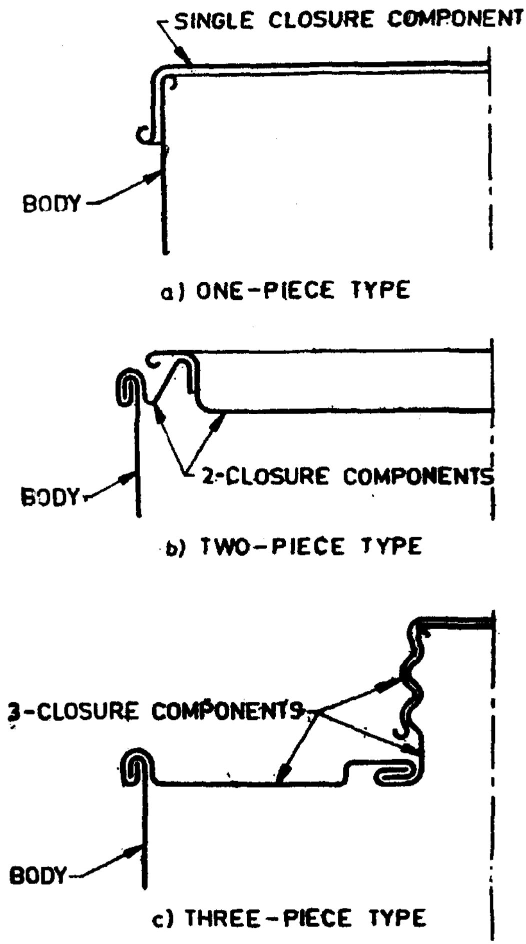


FIG. 5 CLOSURE TYPES FOR BUILT-UP BODY

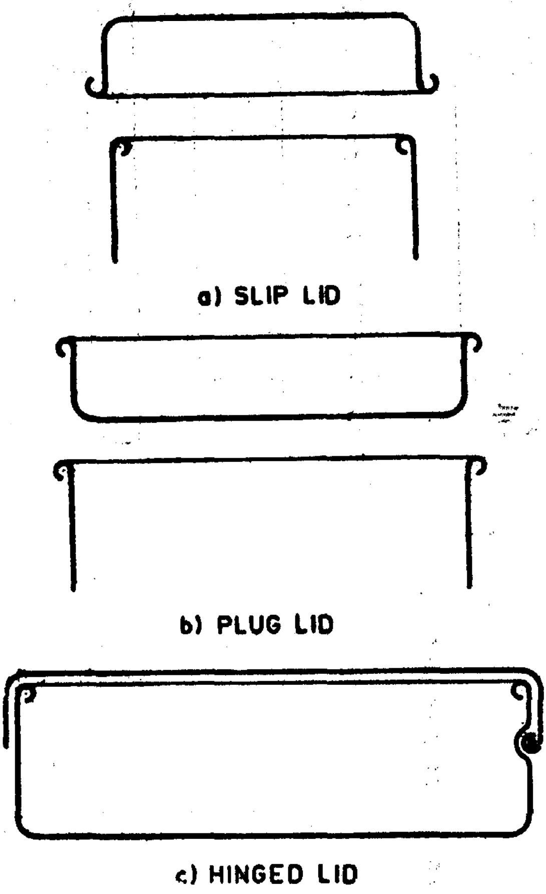


FIG. 6 TYPICAL ONE-PIECE CLOSURES

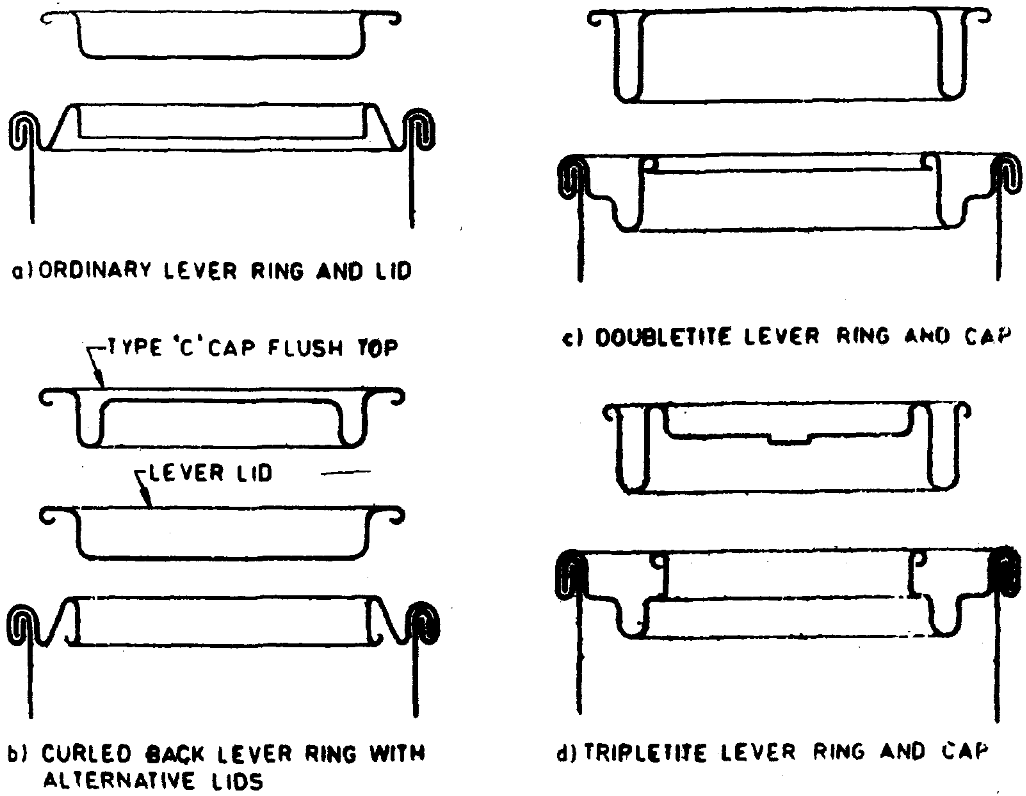
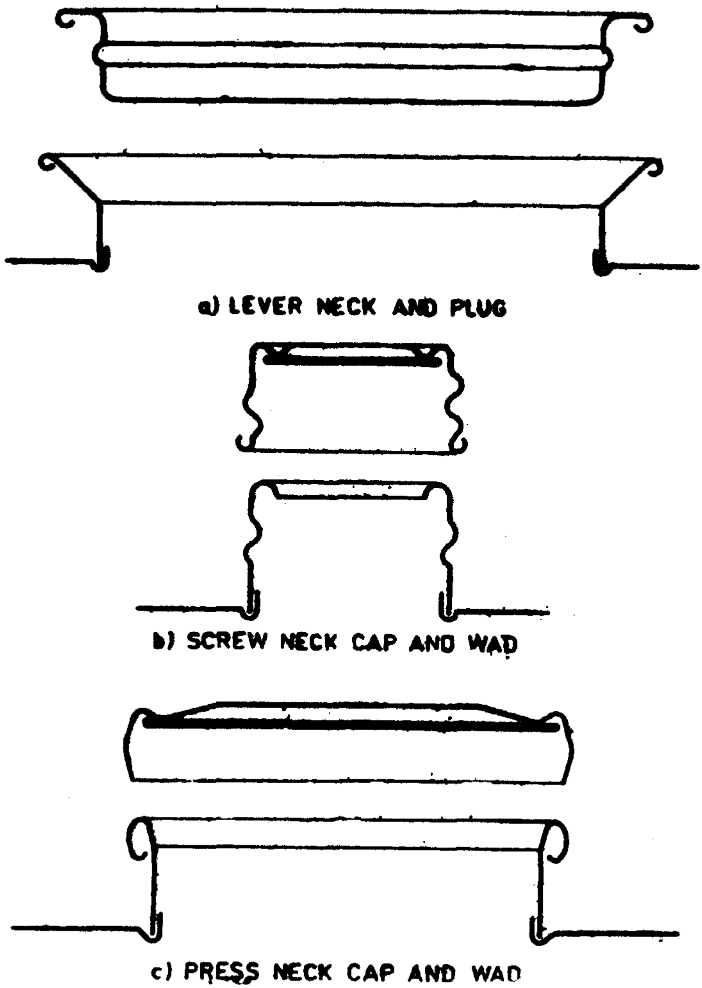


FIG. 7 TYPICAL TWO-PIECE CLOSURES



NOTE — These pieces comprise:

Cap

Neck

Top component (fixed to body of tin).

FIG. 8 TYPICAL THREE-PIECE CLOSURES

On tinplate, aluminium and blackplate, the background colour has to be printed on to the metal, unlike paper which in its natural condition already has a background colour.

Any subsequent pressing or drawing distorts the metal and the contour of the pressed shape causes a marked change in the way the light is reflected from the surface, thus giving the impression of a difference in colour. A pressed lid, for example, should not be designed to match exactly the colour of a rolled body. It is more effective to introduce a band of another colour where two components meet or to use contrasting colours for the two components.

2.7.2 *Proof and Black Impressions* — Unlike printing on paper, full colour proofing is not generally practicable on metal. Paper impressions, or 'pulls' off the original lithograph are taken instead in black. At this stage, the reproduction is already complete and alterations usually mean a fresh start. Where the design includes type matter (for example, directions) it is best to approve the typeset before it is embodied in the lithograph. Type can be altered fairly readily.

2.8 Testing

2.8.1 Tins and cans are tested by means of air pressure, although the basic methods are described as 'water testing' and 'vacuum testing'. The difference lies in the process of diagnosing the passage of air through a leak. These two methods are described in **2.8.1.1** and **2.8.1.2**.

It may be unwise for the purchaser to specify the routine tests that should be carried out, as the details of a test are correct only for one particular tin in one particular circumstance. A better alternative is to leave the routine test open to the discretion of the manufacturer and to lay down a final performance, which the tins supplied shall be capable of achieving, the ability to withstand.

14 kPa* air pressure under water for 15 s without leakage is known to be a reliable performance rating strictly within the limits of usefulness of testing, as defined in this section of the code. The manufacturer can adapt his testing procedure (to achieve such a performance rating) as best suits the hazards of his manufacturing process and of the particular tin.

There are many characteristics which need to be considered in deciding upon a satisfactory tin and these cannot be checked by water or vacuum testing. The latter tests reveal the major faults, but even high pressures do not detect a sound but mechanically weak joint. They will not detect tins or cans which are liable to leak under subsequent stress.

*1 kPa = 0·0 102 kgf/cm^2.

To increase the tinplate thickness is no remedy; it can increase the hazard, since the first requirement of a sound joint is that its elements should lie in intimate contact with one another.

The suitability or otherwise of the closure relative to the nature of the contents and circumstances is not determined by 'testing' within the sense of this clause, nor do the tests described disclose the compatibility of the ultimate contents and dopes or lining materials used to seal a joint.

2.8.1.1 *Water testing* — Air under pressure is introduced into the tin through the closure orifice and the tin is then immersed in water. Passage of air through a leak is observed and located by the consequent stream of air bubbles. The efficiency of the test is not a simple function of the air pressure applied. The air pressure should be applied before the external surface of the tin is wetted by the water; otherwise, with very fine capillary leaks, water will be drawn into the capillary and the testing pressures which the tin will withstand will not dislodge that water. Thus, no air will pass.

The tin should be tested rather than physically stressed beyond its intended resistance to deformation. Leaks can be induced (later, if not immediately) by excessive pressures.

The use of warm water and/or the addition of wetting agents lowers the surface tension of the water and thereby reduces the back pressure at the water/air interface. Thus, a more rapid stream of smaller air bubbles will result and the time lag will be reduced.

2.8.1.2 *Vacuum testing* — The pressure differential is achieved by partial evacuation of the tin. The negative operating pressure could, unless controlled, run down to 736 mm Hg, resulting in an external pressure approaching 1 atm, that is, 100 Kpa (1·03 kgf/cm^2), but a strict limit is imposed by the inability of the side walls of a tin to withstand externally applied pressures of any magnitude.

NOTE — The resistance to external pressure is greatest with the cylindrical shape and where the superficial area of the body wall is less than half the total superficial area of the tin. The resistance of very small tins is ignored, since it is not being considered here.

Because there is no air/water interface, the resistance to the passage of air through a fine capillary is lower than in the case of water testing. But lower pressures must be employed to avoid stressing the tin. The existence of a leak is detected by a rise in pressure within the tin due to the ingress of air and is indicated either by a manometer or by a bourdon tube vacuum gauge. Neither type of instrument will disclose fine leaks, since the former suffers from surge effects and the latter from wear due to repeated and violent stressing of the gauge mechanism over long periods of use.

2.9 Filling and Closing

2.9.1 *Filling* — Overfilling is a common source of leakage with liquid products and care should be taken to determine the appropriate gross (closured) volume of the tin. This must allow not only for expansion of the contents and rise of vapour pressure, but for variation in the accuracy of filling the tin and, indeed, in making the tin.

2.9.2 *Determination of Gross Lidded Volume* — The following procedure enables the true gross lidded volume to be measured. The volume of the annulus between any plug fitting lid (such as a lever lid) and the body — and the volume of any dome or recess in the lid — are not ignored by this method. Such volumes constitute effective headspace. Their significance is greatest with the smallest tin.

a) Drill (in the direction inside to outside) two 6·3 mm diameter holes in the bottom of the tin and adjacent to each other.

b) Fit all the closure components (just as though the tin had been filled) being careful to ensure that none is omitted, for example, the inner seals in screw necks, plugs in seamless necks. Lever lids must be driven home correctly.

c) Weigh the closed (empty) tin in grams.

d) Fill the closed tin with water at room temperature (between 15° and 25°C, or between 60° and 75°F) from a narrow water jet through one of the holes with the container inclined at an angle to the vertical. When water first runs out of the second hole, ensure complete filling by closing the holes with the fingers, gently shaking the can and completing the filling. Remove all surface water carefully.

NOTE — Alternative method of filling the closed tin:

Drill two 6·3 mm diameter holes (in the direction inside to outside) in the bottom of the tin, diametrically opposite to each other and each as close as possible to the circumference of the bottom. Immerse the tin, bottom upwards, in a bucket or tank of clean water (at room temperature, as defined above). Tilt slightly to dispel any residual air pocket. Withdraw the tin vertically and remove all surface water carefully.

e) Weigh the filled tin in grams.

f) The difference between the empty and full weighments expressed in g gives the capacity of the container in millilitres.

2.9.3 *Ullage or headspace* — Ullage is expressed as a percentage of the net volume as declared for sale. It is not expressed as a percentage of the gross lidded volume of the tin.

NOTE — This comment relates only to the manner in which ullage is expressed, for example, it has no bearing on the method of calculating the appropriate ullage allowance, which varies with the commodity.

2.9.4 *Closing* — The advice of the container manufacturer should be sought as to the appropriate method and equipment for closing the tin. Irreparable harm can be done to the container by faulty equipment or methods.

The use of a lidding machine is recommended for inserting lever type lids, and the application of the shoulder to sprinkler powder (for example talcum powder) calls for special equipment and considerable care and skill if permanent damage and leakage are to be avoided. Certain types of tins, for example cutter lid or solid ring, are filled through the open end, in which case the end is subsequently fixed by a spinning process known as double seaming. For liquid products and all weights over 1·8 kg, ' stand still' type of double seamer is safer and batter. The rotary type machine wherein the tin and not the seaming mechanism rotates, is otherwise generally suitable and more easily maintained*.

The double seaming of ' irregular ' tins (which term implies all shapes other than cylindrical) requires a special and more complicated type of machine operating more slowly and requiring considerable skill to maintain.

In either case (cylindrical or irregular), a clear distinction should be made between the following two aspects of the operation:

a) Mechanically attaching the end to the container; and

b) Sealing the joint so made, either in relation to retention of the contents or to the isolation of the contents from external conditions, for example, water vapour.

The two facets are not synonymous; the former can be accomplished without achieving the latter, which requires special arrangements and particular care and attention all round.

2.9.5 *Vacuum Packing* — Tins lend themselves, within certain limits of size, shape and type, to packing ' under vaccum '. This term implies that some, but not all, of the air is exhausted prior to sealing the tin. The degree of evacuation depends upon the extent to which the tin will withstand the external pressure created. Complete evacuation would set up an external pressure of nearly 0·1 MPa (1·05 kgf/cm^2).

There are two basic processes. The simplest is the atmospheric pressure seal type wherein a resilient sealing gasket is imposed between the lid and the body. A mechanically robust seal is established without

*But the quality of double seam is generally inferior to that obtained with a ' stand still ' type of double seamer.

any mechanical jointing operation. After partial evacuation, the pressure difference between the inside and outside of the tin must be great enough to compress the sealing gasket between the lid and the body. The result is a secure seal even under quite severe conditions of handling. Such tins are opened by ' breaking ' the vacuum, the commonest method being to disturb or distort the sealing gasket locally. The atmospheric pressure seal type of vacuum tin is restricted to the seamless body types and to the round shape in all but a few exceptions of a highly specialized nature.

The second type of vacuum sealed tin comprises a mechanically formed seal, for example, a double seamed end. Such types can be double seamed within a vacuum chamber by what is known as a vacuum double seamer (round shapes only) or by the cabinet process. In the latter case, the mechanically sealed tin is pierced at the top with a small hole having the contour of a ' burst ' rather than that of a clean puncture. A pellet of solder is placed over the hole (or fused to the tinplate adjacent to the hole). Arrangements are required for fluxing (fluxcored wire solder is effective) and a batch of tins thus prepared is placed in a stout vacuum cabinet and the door sealed. After partial evacuation of the cabinet (and of the pierced or 'brogued' tins) and electrically heated soldering iron operating through a sealed universal joint in the top of the cabinet is used to solder up the brouge holes, under vacuum. The vacuum in the cabinet is then 'broken' and the sealed tins are removed.

The process will handle any size or type of sealed tin, the limiting factor being mechanical strength of the tin under partial vacuum. Just as in the case of vacuum testing (*see* **2.8.1.2**), the resistance to external pressure is greatest with the cylindrical shape and where the superficial area of the body wall is less than half the total superficial area of the tin. This implies squat, cylindrical tins. But the shape of the tin is a function of the pressures involved. If only 50 percent of the air is to be exhausted, the pressure difference and the stress is reduced. It follows, therefore, that the restriction on the proportions of the tin is likewise 'eased'. Where the air is all but completely removed, the pressure difference imposes a limit to the size of the tin; 127 mm diameter is almost the maximum.

2.9.6 *Inert Gas Packing* — The process is a variant of the vacuum packing method. The bulk of the air is first removed by evacuation and the vacuum is replaced by admitting an inert gas—usually carbon dioxide or nitrogen—whereupon the tins are carefully removed from the gassing cabinet and the brogue holes are soldered up in any convenient manner. The process does not create any physical stress on the tin, since the evacuation cycle is carried out with equalized pressures within and without the tin; that is, in a chamber. Although there is no limit to the size or shape of tin which may be gas packed, a mechanically sealed tin is required. There is no simple routine method of detecting unsound tins, as there is with the vacuum pack.

The process permits removal of air, so that in many ways it performs the function of vacuum packing. Because the tin is not under the stress of internal or external pressure, there is no restriction on proportions, shape or size of tin which may be used, provided the tin can be hermetically sealed and the contents do not develop any internal pressure. The process, of course, is not applicable to the atmospheric pressure type of seal described in **8** for the seamless (solid drawn) body.

2.10 Stacking — The facility of readily stacking one container on another represents a considerable convenience factor.

The basic principle of a ' stacking feature ' is to provide corresponding locating faces on the top and bottom components, so that one 'nests' into the other when stacked.

Such a feature makes it possible to form tiers of containers, without resort to careful balancing. This is particularly useful when arranging containers for sales display or storage.

2.11 Aerosol Dispensers — The basic principle of this method of packaging is that of packaging products in containers which are fitted with suitable valves and then pressurized with selected propellants. The choice of valve type and propellent will determine the form in which the product emerges. This form can vary from a true aerosol to a foam or semi-solid extrusion.

The container itself should be adequate to withstand the high and sustained internal pressures created by the propellents.

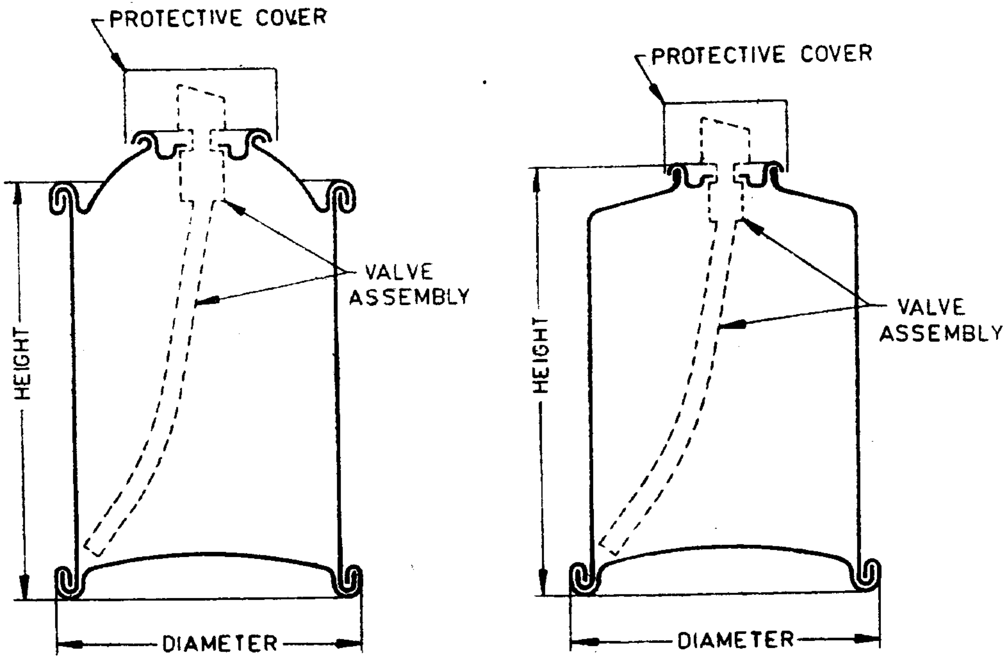
The most common tinplate aerosol containers are made with a special type of side seam and are fitted with seamed-on top and concave bottom ends. Aluminium aerosol containers may be of either one or two piece construction. Both have seamless bodies, but the latter has a seamed-on concave bottom end.

For typical aerosol dispensers *see* Fig. 9 and 10.

In the majority of cases, the containers are fitted with a normal 25 mm aperture into which the valve with a standard mounting cup is crimped. For the smallest one piece aluminium extrusions, a 21 mm aperture is used. With these small containers, valves with ferrules for fitting on to glass bottles are used.

3. DRUMS

Metal drums, because of the wide range of designs and closures available, are used for packaging all forms of solids, powders, crystals, pastes and liquids.



a) BUILT-UP TYPE (TINPLATE)

b) SEAMLESS SIDE WALL TYPE (ALUMINIUM)

FIG. 9 AEROSOL DISPENSERS

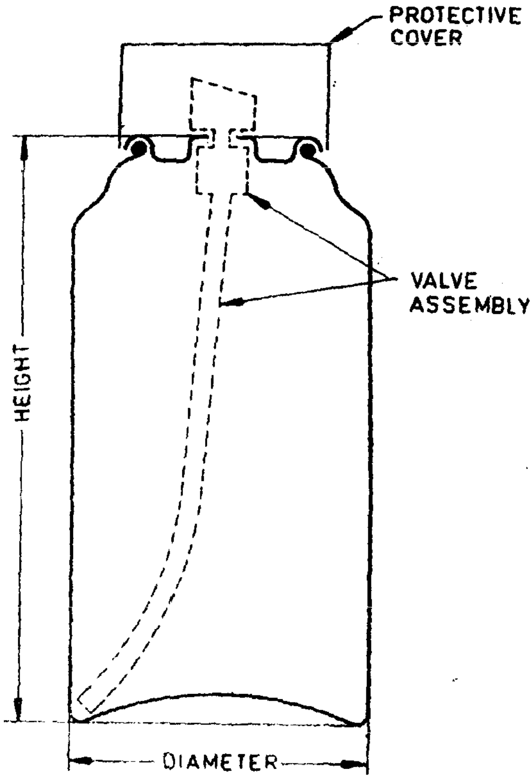


FIG. 10 AEROSOL DISPENSER, SEAMLESS BODY TYPE (ALUMINIUM)

They are impervious to air, light and water, completely resistant to insect and rodent attack and capable of withstanding without additional packaging, rough handling during transit. The exteriors may be finished to portray brands and general publicity matter. These factors make metal drums a versatile form of packaging for use in all areas, irrespective of climatic conditions or transit hazards.

This code aims to give only the broadest descriptions, as a guide to assist users in their selection of the most appropriate drums for their particular needs.

No attempt has been made to lay down rigid specifications. Users should satisfy themselves that the type of drum, the material or protection

as between material and contents, and the closures, are suitable and compatible with the product to be contained.

Attention is drawn to the more detailed Indian Standards Specifications, that is:

IS : 5682-1970 Open top drums and kegs,

IS : 1783-1974 Drums, large, fixed ends (*first revision*)

IS : 2552-1979 Steel drums (galvanized and ungalvanized) (*second revision*)

IS : 2474-1968 Specification for closures for drums

IS : 1784-1977 Specification for screwed closures for drums (*first revision*)

3.1 Classifications

The following basic classifications are used in this code:

Type A — Steel drums (galvanized and ungalvanized) (*see* IS : 2552-1979) (*second revision*)

Type B — Open top drums and kegs (*see* IS : 5682-1970)

Type C — Drums large, fixed ends (*see* IS : 1783-1974) (*first revision*)

3.2 Materials — Drums are most commonly made from uncoated mild steel sheet, but for certain usages and conditions they may be manufactured from other materials, such as:

a) Galvanized steel sheet,

b) Tinplate,

c) Lead coated or terne coated sheet,

d) Aluminium alloy sheet, and

e) Stainless steel sheet.

3.3 Types and Uses of Drums

3.3.1 The following are the four types of drums:

a) *Type A drums, steel* (*galvanized and ungalvanized*)

These have been divided into five grades, depending upon the type of material to be packed, ranging from highly inflammable products like petroleum and chemicals with flash point below 24·4°C to non-toxic and non-hazardous materials.

The detailed specifications of these drums with capacity range from 3 to 150 litres have been covered in IS : 2552-1979.

b) *Type B — Open top drums and kegs* — These are used for the packing of solid dry and semi-solid paste-like items of non-hazardous type. These are fitted with top-ring closures which can be fully removed to ease the take out of the materials. The detailed specifications of these drums up to 200 litres capacity have been covered in IS : 5682-1970.

c) *Type C — drums large, fixed ends* — These are large barrels of 200 litres nominal capacity used for the packing of petroleum products, lubricating oils and other chemicals of industrial use. Depending upon their use and handling, these have been divided into three grades : Grade A, Grade B and Grade C. IS : 1783-1974 gives the detailed specification of these drums.

d) *Type D — bitumen drums* — These are non-return type drums with special type of closure, specially designed for the packing of bitumen. IS : 3575-1977 covers the detailed specification of these drums.

3.4 Closures for Drums

3.4.1 Reference may be made to IS : 2474-1968 Specification for closures for drums.

The following types of closures are covered in this standard:

a) 75- and 100-mm separate neck with inner plug and cap seal,

b) 32- and 44-mm tapered spout with inner plug and cap seal,

c) Integral neck with plug and cap seal,

d) Lever lid, tight fit; and

e) Screw-on type brass bung and faucet.

3.4.2 *Screwed Closures for Drums*

For this purpose, one may refer to IS : 1784-1977 Specification for screwed closures for drums (*first revision*).

3.5 Internal Treatment and Linings — The interiors of steel drums can be coated with a wide range of protective coatings, ranging from simple air drying rust preventives to high grade chemical resistant stoved lacquers.

Loose liners made from rubber compounds and plastics are used extensively in open top drums.

Plastics semi-rigid liners produced by moulding or sintering as a specific component for both open top and fixed end drums are also available.

3.6 Exterior Finish — The use of modern durable high grade paints for containers made from materials needing protective coating and the facilities to incorporate by lithography or screening detailed coloured publicity matter add sales appeal to the drum.

4. METAL CRATES, HAMPERS AND TRAYS

4.0 General — Metal crates fitted with partitions and intended primarily for carrying bottles and jars have been used widely for a considerable time, as have metal carboy hampers. More recently, other types of metal crates have been developed for general packaging purposes, and they are often used as alternatives to the familiar wooden crates. In general, they have so far been confined to home trade use, but some industries, for example, glass, pottery and sanitaryware, have used them successfully for export trade.

Metal trays are used primarily for agricultural and horticultural produce, especially for soft fruits.

4.1 Definitions

The following are the principal terms used in relation to metal crates and trays :

Crate	A metal framework, with or without a lid, used for packaging articles for which a solid box is not considered necessary.
Bottle crate	A crate fitted with partitions, each compartment being designed to hold one jar or bottle.

NOTE — The term 'bottle crate' is also used by glass bottle manufacturers and in certain other industries to describe a 'general purpose crate' used primarily for packing empty bottles in bulk; if the term is used in this sense, it may include collapsible types.

General purpose crate	A crate, usually rectangular, with the internal space clear of any major protrusions.
Pallet or stillage crate	A crate fitted with feet specially designed for use with fork trucks and pallet trucks.
Skip or hamper	A metal framework, with or without a lid, used chiefly as a casing for glass or stoneware containers.
Tray	A shallow lidless rectangular container not more than 230 mm deep, of mesh or solid or perforated sheet, strip or wire, with or without a handle.

4.2 Styles

Metal crates, hampers and trays may be manufactured in a wide variety of styles, which are frequently designed specially for the product to be packed.

Crates may be formed to any shape and may be made with or without lids. As they have no internal fitments, such as divisions or other means of positioning the contents, they may be of rigid or collapsible construction. Collapsible crates may be stored in the form of flat panels to save storage space, and may also be transported in this manner to save freight.

Some types of crates may be nested to facilitate storage and for ease of transportation. The most usual types of non-collapsible crates intended for nesting are as follows :

a) Tapering cylindrical hampers.

b) Rectangular 'boxes' with the overall size of the base less than the aperture, that is, with tapering sides and ends.

Other types of crates are provided with compartments or divisions to hold individual articles; these are used chiefly for bottles, jars, etc, and are more fully described in **4.3**.

Trays may be of solid sheet or may have perforations for ventilation or drainage, or they may be of wire or strip mesh; they may be fitted with handles, stacking devices or identification labels.

The two chief types of hampers are the tapered cylindrical carboy hamper and the straight-sided cylindrical demijohn crates. These are made with or without lids, which may be flat or conical.

It is not practicable to lay down precise specifications for metal crates in a general code of this kind, but the principal types are more fully described in **4.3** to **4.6**.

4.3 Bottle Crates — Bottle crates usually consist of a rigid framework with a solid or slatted base. They are provided with bottle locations in the form of suitable sized reinforced holes in a metal tray/trays fixed horizontally in the crate or formed by intersecting metal strips running from end to end and across the crate.

Steel crates are usually of welded construction and are protected against corrosion by galvanizing or painting; they may be made from strip or wire.

Light alloy crates are made from mixed aluminium and magnesium alloy, aluminium alloy or magnesium alloy and are riveted or riveted and welded. They may be protected by a suitable chemical treatment and a clear stoved varnish. Light alloy crates often have rubber grommets and buffers on which the base of the bottles rests; these hold the bottles in position, minimize noise and absorb shock. Light alloy crates are usually interstackable with corresponding wooden crates. The name of the owner may be branded, embossed or painted on either the end or the side.

Bottle crates have their widest use for milk, beer and soft drinks. The majority of the crates used by the brewing industry are in sizes to hold twenty-four 325 ml or twelve 650 ml bottles. Other sizes include those to hold twelve 325 ml, 650 ml, four 1 litre and six 1 litre bottles. The average weight of the most commonly used light alloy crate is 2·7-3·2 kg and the corresponding steel crate weights 4·5-5·4 kg.

Table 5 gives the approximate dimensions of the commonly used bottle crates.

TABLE 5 SIZES OF BOTTLE CRATES

No. of Apertures	Size of Aperture (mm)	Approximate Weight of Crate (mm)
4	95·0	345
12	67 — 71·0	181 — 241
12	79·5 — 84·0	305 — 346
24	67·0 — 71·0	181 — 241
24	79·5 — 84·0	305 — 346

4.4 General Purpose Crates — These are usually rectangular, providing a clear internal space. Their widest use has been for such articles as pottery, glassware, sanitaryware, hollow-ware, and fireclay products, which are surrounded with cushioning material which serves to prevent contact between the individual articles and to fill the crate. They are also used for over-packing cartoned goods. Such crates may be constructed with collapsible sides.

This type of crate is usually made from welded or woven wire mesh, or from welded or riveted strip. It is often, though not always, provided with a lid, and bracing may be incorporated to provide additional strength.

Rigid crates, made from welded steel wire mesh are used, for example, in the glass industry for the conveyance of bottles and jars from

the glass manufacturer to the user. They are manufactured by using one sheet of mesh for the base and sides, the ends being welded in. These crates are supplied in different sizes according to the particular requirements of the packer; an open top crate, without additional packing, can carry up to 200 bottles.

The collapsible types of steel wire crates used chiefly in the pottery, glass and hollow-ware industries are made from high tensile welded wire mesh, usually $75 \times 75 \times 5{\cdot}4$ mm weighing $4{\cdot}7$ kg/m^2. The sizes range from $750 \times 750 \times 750$ mm to $1\,450 \times 915 \times 760$ mm.

The larger sizes can safely carry weights up to 500 kg or 600 kg and meshes of heavier gauge can be supplied to carry even greater weights.

Welded steel wire mesh crates occupy a comparatively small area when stored in collapsed form, save cubic capacity and are not subject to any appreciable damage in transit.

The welded wire mesh from which these crates are made warrants special mention. It is made from high tensile drawn steel wire and is welded at every point of intersection. The most commonly used sizes, apertures and weights are shown in Table 6.

TABLE 6 STEEL WIRE MESH FOR GENERAL PURPOSE CRATES

Aperture Size (mm)	Diameter (mm)	Weight (kg/m^2)
75 × 75	5·4	4·7
50 × 50	4·1	4·0
75 × 25	3·3	3·5
50 × 25	4·1	6·0

General purpose crates are sometimes made from aluminium or magnesium alloys.

Handles are either formed in the end panels or are of a variety of standard steel fabricated handles riveted on in conjunction with an internal spreader plate. Construction is generally by riveting, the individual component receiving an appropriate heat treatment if necessary at some stage in its manufacture.

4.5 Pallet or Stillage Crates — A modified form of the rectangular crates described in **4.4** is fitted with feet which are specially designed to facilitate the use of mechanical or hand-operated fork trucks and stackers; they are designed for stacking, and may have collapsible sides.

4.6 Hampers — Perhaps the best known example of the metal hamper is that used by the chemical industry for the packaging of acids in glass carboys. Cushioned in straw, wood-wool or some other suitably resilient material, the carboy is cradled in the hamper and protected from the shocks and jolts of normal transport.

Hampers were formerly made in wicker construction which was very effective and is still used. However, now the 50 litres globular carboy hamper is often constructed, from steel strip or from round iron.

For hampers made in steel strip, the usual methods of construction embrace riveting, clenching and welding. Where round iron is used, welding and knuckling are principally employed.

Detail of design is open to considerable variation, though choice is generally limited by cost. The more important factors are not so much details as those involved in providing a construction which has adequate strength within cost limitations and, primarily, which conforms to the users' needs in regard to accuracy of overall dimensions.

The 50 litres globular carboy packages still probably account for the largest use of flat strip and wire hampers, but now smaller hampers, generally with straight sides, are also used in very large numbers for carboys, demijohns, and stoneware jars ranging in capacity from 5 to 20 litres or more. These hampers are usually provided with a hood or cover which may be conical or flat in shape. Their construction is similar to that of the large carboy hampers and they are made from flat steel strip or round iron, fastened together by clenching, riveting, welding, etc.

Recently, there has been evidence of the desire to improve upon the earlier hamper. With little room for improvement in regard to strength *and degree of protection given, the trend has generally been towards* enhanced appearance and improvement in handling; development on both these lines is likely to be diverted towards the use of single hampers having straight sides and fitted with covers, in place of the curved side hamper with safety crate and hood. Painted in bright colours, such hampers present an altogether more attractive package than does the conventional pack which is tar-dipped or black varnished. In freight economies, and in handling, the single straight-sided hamper is likely to offer many advantages.

4.7 Trays — Metal trays can be designed for many different uses, for example, for carrying bottles, or for soft fruits and other horticultural produce. They may be fitted with handles, handholes or stacking devices.

They may be manufactured from high tensile welded steel wire mesh, expanded metal, perforated, ribbed or flat sheet, or from woven

crimped wire mesh or strip. The material is usually low carbon steel, stainless steel, aluminium or aluminium alloy. If trays are used for foodstuffs, the material should be carefully selected to avoid the danger of interaction between the commodity and the container. Advice on such matters can usually be obtained from the suppliers of the material.

The sheet gauges used range from 1·20 to 3·25 mm. In some instances, corner posts in the form of aluminium alloy castings are incorporated to increase resistance to rough handling and to provide interestacking.

4.8 Identification — Crates, trays or hampers made from sheet or strip can be embossed with identification marks or letters. The identification of wire mesh containers is achieved by the use of a metal plate or label attached to the framework. Wire letters may be used in wire mesh crates.

5. METAL COLLAPSIBLE TUBES

5.0 General — Collapsible tubes are eminently suitable containers for materials in paste or semi-liquid form which require to be kept free from contamination or from contact with air during storage and use.

They are generally made in 15 diameters, ranging from 12·7 to 60 mm and tube lengths ranging from 60 to 160 mm. Such tubes are particularly suitable for packing:

a) Pharmaceutical preparations,

b) Tooth-pastes and shaving creams,

c) Foodstuffs of suitable nature and consistency,

d) Formulations containing volatile constituents like rubber solutions, and

e) Printing inks.

All collapsible tubes may be manufactured with protective coatings externally or internally, as required.

Each sealing compound may be applied to the inside open ends of the tubes (*see* **5.6**) and may be formulated to suit particular products. The user should ensure by means of practical tests that the complete package is suitable for his product.

The following Indian Standard relates to collapsible tubes:

IS : 3101-1979 Aluminium collapsible tubes (*first revision*).

5.1 Materials — Collapsible tubes are usually made from aluminium, and coated internally and externally.

5.2 Dimensions — The dimensions and nominal capacities of the standard range of tubes and the normal range of nozzles, orifices, and moulded caps are given in IS : 3101-1979. Special tubes and variety of nozzles and applicators are made to suit special purposes. Details of nozzles for eye-ointment tubes have been covered in IS : 7852-1975 Specification for eye ointment tubes, small.

For certain industrial uses, and where winding keys are used for stiff products, a greater wall thickness may be necessary for the tube; it is recommended that tube manufacturers should be consulted in such instances, as no general guidance can be given.

5.3 Decoration and Identification — Collapsible tubes are supplied enamelled and printed in any design required, or they may be supplied plain. The shoulders may be embossed or machined and the moulded cap can carry a name or monogram.

Code and batch numbers may also be incorporated in the printed design. Many filling and closing machines also emboss the closed end with suitable batch identification numbers.

The design may include marks to ensure proper registration on automatic filling machines.

5.4 Closures — Tube caps are usually made in moulded plastics in a variety of colours, shapes or designs and are fitted with a variety of wads to suit the contents.

Wadless caps can also be supplied.

5.5 Packaging and Transport — Collapsible tubes for home trade are packed in rigid divisioned containers made to fit the various sizes of tubes, and are normally delivered by road in the manufacturer's vehicles. Tubes for export are packed in the same type of container which is, in turn, packed into a wooden case. The quantity in such cases varies with the size of the tube. For the medium sizes about 3 000 for a case is the usual quantity.

5.6 Filling and End Sealing — The filling of collapsible tubes is usually done on specially made filling machines. Small quantities are normally filled on hand operated machines. Large quantities are filled on high speed fully automatic machines.

Closing is normally done by folding and crimping the end of the tube. The efficiency of the crimp seal can be enhanced by using tubes supplied with a band of sealing compound applied to the inside open end. The selection of sealing compound should be governed by the nature of the product packed and the anticipated service conditions. The crimping operation is performed by the filling machine after filling.